Integrated Risk Management Application (IRMA) Overview/Update

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How the Risk Management is Implemented

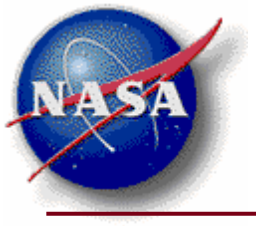
- Process requires risk identification and management to occur in a tiered, integrated, structured manner (increase efficiency and effectivity)
- Ensures that significant risks receive an appropriate level of management review and resources to effectively mitigate significant threats as early as possible
- Information is flowed up, resources and prioritizations are flowed down, while coordination is made between responsible/affected organizations
- Even though secondary to Safety, imbeds Cost and Schedule risks tracking into the integrated RM process for effective mitigation.
- Integration of risk process, tools and systems with other programs and centers

Elements of an Effective Risk Management System

- "Buy-in" and communication to entire program of it's emphasis and need by Management
- Develop comprehensive Risk Management Plan for each Program/Directorate
  - Common Definitions (Risk, Success Criteria, Acceptable Risk, …)
- Implementation of a continuous process for identification, assessment, mitigation planning, tracking and control with effective and timely communication
  - Keep safety paramount
  - Be proactive
  - Keep system simple and easy to use and provide sufficient training
- Provide multiple routes for issues to be elevated for discussion so that management obtains relevant information to be able to effectively mitigate threats in a timely manner (also, provides necessary "checks and balances")
  - Incorporates "appeal process" for rejected risks or to log a dissenting opinion on a risk or the handling strategy
- Integration of risk management throughout Program (imbed in existing board process – becomes part of the management infrastructure)
  - Leverage off existing analysis and management processes
  - Risk Management should be part of everyone's job description
- Create Effective 'Flow" of Risk Data
  - Everyone's "concerns" should be heard and evaluated
- Need effective tools, training and processes
  - IRMA
- Allow for the seamless integration and cross communication between programs of common risks
  - Provide "one-portal" for management insight into all program risks (through One NASA MIS link)

The IRMA Tool at JSC

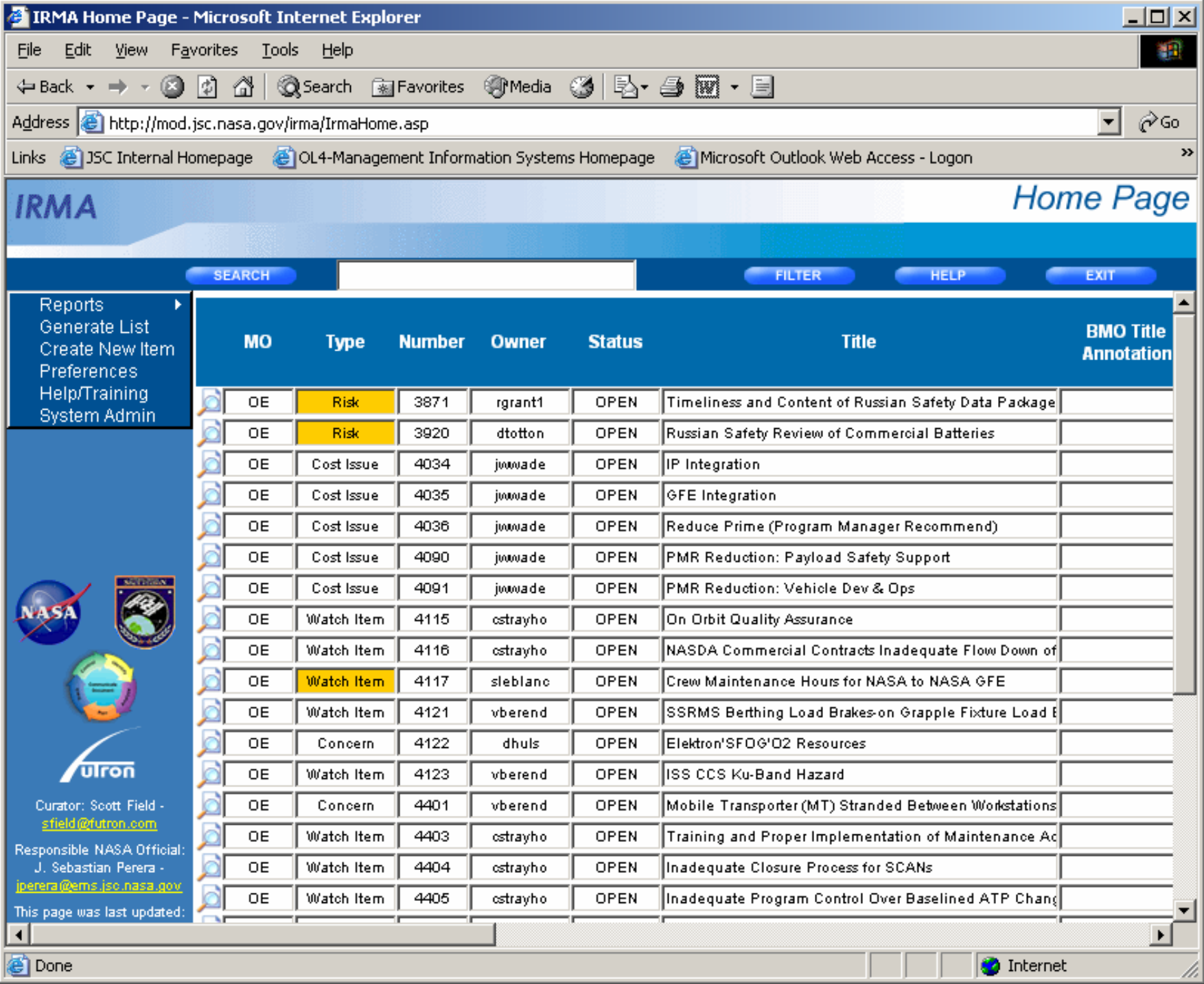
- NASA developed web-based database used by (ISS, SSP, JSC, and other groups) to identify, plan, track, control and communicate risks and risk data
  - Facilitates management of technical, costs, schedules and safety facets
  - Tiered levels
- Provide the following facets
  - Risk description (risk statement & context)
  - Risk scoring/ranking
  - Impacts/Consequences
  - Mitigation plans and their status (burn down process)
  - Risk status
  - Closure/Acceptance criteria & rationale
  - Risk flight tracking/coordination/integration
- Data under configuration management controls



What Metrics Does IRMA Have Now?

These are the metrics that IRMA currently produces:

- **Staleness report** – how often do the individual risk owners manage and update their risk information. Is the risk data becoming stale and not effectively communicating to all risk stakeholders any changes
- **Mitigation Tardiness report** – provides metrics on the timeliness of mitigation plans to insure adequate plans are developed and then executed
- **Time in System report** – provides metric on how long risks are worked in the system before closure – are risks being identified, but plans are not being formulated and executed in a timely fashion?
- **Risk Organization Breakdown report** – indicates the type and quantity of open risks in the system broken down by organization – indicates whether all organizations are actively identifying risks (or only the few major threats to the organization)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Preferences
Help/Training
System Admin
MO Type Number Owner Status Title BMO Title Annotation
OE Risk 3871 rgrant1 OPEN Timeliness and Content of Russian Safety Data Package
OE Risk 3920 dtotton OPEN Russian Safety Review of Commercial Batteries
OE Cost Issue 4034 jwwade OPEN IP Integration
OE Cost Issue 4035 jwwade OPEN GFE Integration
OE Cost Issue 4036 jwwade OPEN Reduce Prime (Program Manager Recommend)
OE Cost Issue 4090 jwwade OPEN PMR Reduction: Payload Safety Support
OE Cost Issue 4091 jwwade OPEN PMR Reduction: Vehicle Dev & Ops
OE Watch Item 4115 cstrayho OPEN On Orbit Quality Assurance
OE Watch Item 4116 cstrayho OPEN NASDA Commercial Contracts Inadequate Flow Down of
OE Watch Item 4117 sleblanc OPEN Crew Maintenance Hours for NASA to NASA GFE
OE Watch Item 4121 vberend OPEN SSRMS Berthing Load Brakes-on Grapple Fixture Load E
OE Concern 4122 dhuls OPEN Elektron'SFOG'O2 Resources
OE Watch Item 4123 vberend OPEN ISS CCS Ku-Band Hazard
OE Concern 4401 vberend OPEN Mobile Transporter (MT) Stranded Between Workstations
OE Watch Item 4403 cstrayho OPEN Training and Proper Implementation of Maintenance Ac
OE Watch Item 4404 cstrayho OPEN Inadequate Closure Process for SCANs
OE Watch Item 4405 cstrayho OPEN Inadequate Program Control Over Baselined ATP Chang
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IRMA

Viewing Watch Item #4115

General | Details | Status | Mitigation | Cost | Schedule

CLOSE | SUMMARY REPORT | DETAIL REPORT | VIEW LOG

- Reports
- Generate List
- Create New Item
- Preferences
- Help/Training
- System Admin

Title
On Orbit Quality Assurance

WBS	Number	Type	Status	Escalation
	4115	Watch Item	OPEN	TOR

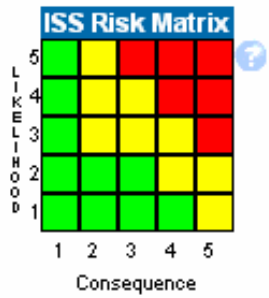
Description
Processes for documenting QA controls and verification of on-orbit repairs/modifications/assemblies are in development.

MO	Risk Owner (Name)	Phone No.
OE	Strayhorn, Carl	281-483-3566

Open Date	ECD	Close Date
7/10/2002	6/1/2003	

Likelihood: None

Consequences: Technical None; Schedule None; Cost None



Total Mitigation Cost

High Est.	Most Likely	Low Est.
$ 0 M	$ 0 M	$ 0 M

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Title
On Orbit Quality Assurance

Type
Watch Item

Number
4115

Status
OPEN

Description
Processes for documenting QA controls and verification of on-orbit repairs/modifications/assemblies are in development.

Impact/Consequence to ISS Program
Inadequate controls and verification of on-orbit items that may undergo repairs and and modifications

Closure/ Acceptance Criteria

Closure Rationale

MO
OE

Flights Affected

Orgs Affected
OE

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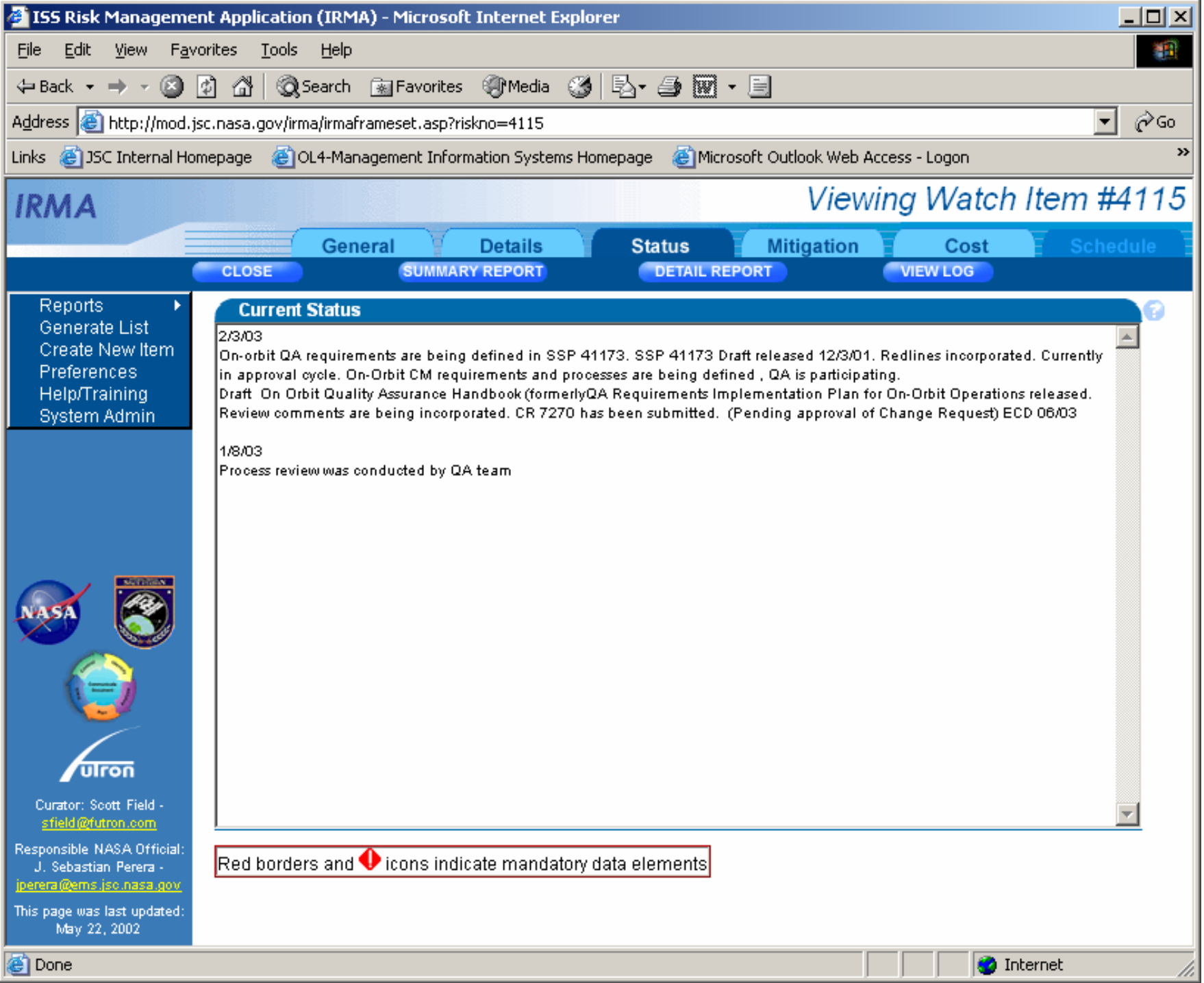
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IRMA
Viewing Watch Item #4115
General Details Status Mitigation Cost Schedule
CLOSE SUMMARY REPORT DETAIL REPORT VIEW LOG
Reports
Generate List
Create New Item
Preferences
Help/Training
System Admin
Current Status
2/3/03
On-orbit QA requirements are being defined in SSP 41173. SSP 41173 Draft released 12/3/01. Redlines incorporated. Currently in approval cycle. On-Orbit CM requirements and processes are being defined , QA is participating.
Draft On Orbit Quality Assurance Handbook (formerlyQA Requirements Implementation Plan for On-Orbit Operations released. Review comments are being incorporated. CR 7270 has been submitted. (Pending approval of Change Request) ECD 06/03
1/8/03
Process review was conducted by QA team
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Mitigation Plan Overview

Fallback Plan

No Mitigation Tasks have been identified.

NEW TASK

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BMO Title Annotation	UPN	Cost Category	Cost Threat	Cost Level
		Prime		

Cost Breakdown

Total	Total High Mitigation	Total Most Likely Mitigation	Total Low Mitigation	Total Mitigation Budget	Total Inaction Cost	Total Actual
	$ 0 M	$ 0 M	$ 0 M	$ 0 M	$ 0 M	$ 0 M

	Mitigation Cost Estimate			Mitigation Budget	Inaction Cost	Actual Expense
	High	Most Likely	Low			
FY02	$ 0 M	$ 0 M	$ 0 M	$ 0 M	$ 0 M	$ 0 M

Comments

Failure to be able to adequately duplicate the on-orbit configuration in ground test faciltiites in a timely manner. This risk in turn implies a threat to Formal Functional Qualification and Stage Tests of Flight Software and testing to

	Mitigation Cost Estimate			Mitigation Budget	Inaction Cost	Actual Expense
	High	Most Likely	Low			
FY03	$ 0 M	$ 0 M	$ 0 M	$ 0 M	$ 0 M	$ 0 M

Comments

Failure to be able to adequately duplicate the on-orbit configuration in ground test faciltiites in a timely manner. This risk in turn implies a threat to Formal Functional Qualification and Stage Tests of Flight Software and testing to

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IRMA Reports

- Flight Affectivity Reports (can pull a report for any given flight to determine all risks against that flight with the mitigations plans and detail risk status)
- Organizations Affected Report (can pull report to find all risks related to a specific organization – whether they are directly managing or are supporting mitigation efforts)
- Metrics reports (e.g., mitigation tardiness and staleness reports to provide statistics on how well organizations are managing risks)
- Budget reports on the cost threats to the Program
- Many other reports

Integrated Risk Management Application
ISS Top Program Risks, July 30, 2003

ISS Program Risk Matrix

Corrective/Preventative Actions

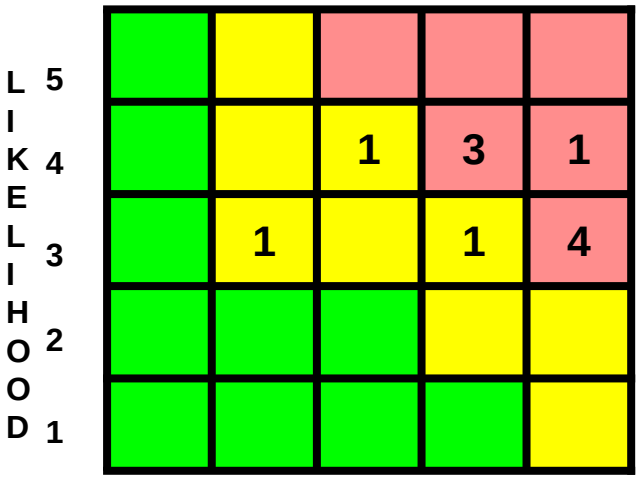
None

Watch Items

- ▲ 4108 - Crew Time for Utilization - OC, SA
- ▲ 4895 - Centrifuge Accommodation Module (CAM) / Rotor (CR) Development - OZ, HQ, ARC, OM
- ▲ 4942 - Node 3 Management/Contractual Dispute between ASI and Alenia for $45M to$75M (OB1) -
- ▲ 4414 - Crew Rotation, Assembly, Docked, and Stage Timelines - CA
- ▲ 4718 - ISS REPLAN - Environmental Health - Radiation Monitoring - SA, OA, OC, OE, CA, OB
- ▲ 4706 - ISS REPLAN - Environmental Health Water Quality Monitoring - OA, OC, OE, CA, SA, OB

Continual Improvement

1. Software Process Improvements – OD & DA



Low	Medium	High
C – Cost	S-Schedule	T-Technical
▲ – Top Program Risk (TPR)		
△ –Proposed Top Program Risk (TPR)		

Risks (L x C)

Score: 4 x 5
- ▲ 4107 - Ability to Support Crew Rescue Beyond 2005 - OI, OA, OG (T)

Score: 3 x 5
- ▲ 2810 - Russian Segment capability to provide adequate MM/OD protection - OC, CA, DA, OM, OE, EA, SA (S,T)
- ▲ 3887 - Funding for External Carriers - ExPRESS Pallets (3), with (24) Payload Adapters - OM, OZ (S,T)
- ▲ 4106 - Ability to Support REMAP High Priority Research - OI, OZ, OM (C,S,T)
- ▲ 4671 - ISS Replan - ISS Continued Manning - OA, OB, OD, OE, OF, OG, OI, OL, OM, OZ, AE, CA, DA, EA, MA, NA, NQ, SA, XA, KSC, MSFC, HQ, ARC, LaRC, GRC, JSC, BOE, GSC, OC (S,T)

Score: 4 x 4
- ▲ 4118 - Internal Active Thermal Control System (IATCS) Coolant Impact to System Integrity (OB3) - OE, SA, OB, OC, OD, OM, OZ, EA, MSFC, BOE (C,S)
- ▲ 3894 - TVIS Functionality and Supportability Plan (OB3) - OB, SA (C,S,T)
- ▲ 3928 - CMG Issues - OD (C,S,T)

Score: 4 x 3
- ▲ 4119 - Delays in Implementation of Acoustic Abatement Plan - OE, OM (C,S,T)

Score: 3 x 4
- ▲ 4707 - ISS REPLAN - Environmental Health System - Air Quality Monitoring - OA, OC, CA, SA, OB (C,S,T)

Score: 3 x 2
- ▲ 4622 - P5 and S5 Robotic Installation - OM (C,S,T)

ISS Risk: 4118 Summary Report

Open Date: 7/10/2002 Status as of 7/30/2003 **ECD:** 8/31/2004

Title: Internal Active Thermal Control System (IATCS) Coolant Impact to System Integrity (OB3)

Description: Several parameters of the IATCS coolant are out of specification and can have potentially serious negative consequences for crew health and safety and IATCS performance degradation. High Total Organic Carbon (TOC), decreasing pH, presence of ammonia, high microbial count, high concentration of nickel ions and discontinuing the use of silver as a biocide are of concern or at issue.

Risk Owner: Rankin, Gary

Likelihood: 4 **Consequence:** 4(C), 4(S), 0(T)

Impact/Consequence: With sufficient time and a lack of preventive'corrective measures, the Coolant conditions can accelerate corrosion of critical hardware and begin to foul system components. If corrosion in the Interface Heat Exchanger (IFHX) causes a breach between the IATCS and the ammonia-based EATCS, then ammonia – at pressures greater than the IATCS MDP – can be introduced into the internal atmosphere of the pressurized elements and result in health'safety threat to the crew. Similarly, corrosion could cause a breach between the low and high pressure sides of the SPCU Heat Exchanger which interfaces with the crew EMU and pose a risk to a crewmember. Corrosion can be the result of chemical or microbial action or a combination of the two. Additionally, the formation of biofilm or solid precipitates in the Coolant can foul components or cause long-term wear'damage. Individual parameters of the Coolant contribute to these overall concerns as described below: TOC (a nutrient source for microbes), although higher than the specification of 5 ppm, is not a concern at levels below 100 ppm. pH below specification of 9 +'- 0.5 can affect corrosion rates and potentially the microbial types and count. Presence of ammonia at low levels has no effect; ammonia is a potential indicator of an IFHX leak. High microbial count can affect biofilm growth'activity and potentially increased corrosion rates and long-term fouling of components. High concentration of nickel ions can result in near-term fouling of the filter and gas trap and affect long-term wear'damage when nickel compounds begin to precipitate out of solution in solid form. The use of silver as a biocide increases corrosion due to a silver'nickel galvanic reaction; without a biocide, the coolant is unprotected against microbial activity.

Managing Org: OB **Orgs Affected:** BOE, EA, MSFC, OB, OC, OD, OE, OM, OZ, SA

Flights Affected: PROG

Total Most Like. Mit. Cost ($M): 2.65 **Total Budget ($M):** 1.05 **Cost of Inaction ($M):** 5

Current Status: 7/18/03 - System continues to nominally operate in single LT mode. MTL PPA serves as a backup and provides fault tolerance for the LTL PPA. Gas Trap and Filter dPs are unchanged. Replacement spare PPA delivered on-orbit on 11P.

- Chemical corrosion coupons have been removed for 300-day analysis. These results are expected to provide additional data that will extend life predictions of both the IFHX and SPCU HX. Plans will be addressed to R&R the SPCU HX to evaluate actual corrosion rates if the useful life of the heat exchanger is approaching limit predictions.

Summary

- Currently the process created for ISS (including the risk database – IRMA) is implemented or being implemented for other programs
- Facilitates:
  - Technical assessments
  - Trend analysis
  - Analysis and review of known risk areas
  - One NASA MIS metrics interface
- Working to develop of common infrastructure (to establish One-NASA RM processes and tools)
  - Need to bring all processes and infrastructure into consistent, cohesive and integrated system
  - Must ensure common processes and infrastructure so that risks can be coordinated between programs/directorates/centers and integrated, elevated and communicated to NASA management.
  - This integrated approach makes it easier to manage risks across programs and centers and will provide “risk visibility” to all levels of NASA management
  - Allows independent groups to have detailed insight into program risks (can facilitate trending and other analysis to ferret out “trouble spots”)
  - Working with Carnegie-Mellon University (creator or Continuous Risk Management/CRM adopted by NASA, to enhance IRMA CRM capabilities)
- Provide necessary checks and balances to insure that issues and threats are caught and dealt with in a timely manner
- Keep risk management system simple, accessible and integrated

Backups

NASA Risk Summary Card

NASA RISK MANAGEMENT

RISK DEFINITIONS

RISK: A Risk is any circumstance or situation that poses a threat to: crew or vehicle safety, Program controlled cost; Program controlled schedule; or major mission objectives, and for which an acceptable resolution is deemed unlikely without a focused management effort. Agreements between other NASA Programs or outside entities (commercial or governmental) that are not being fully implemented must be documented as risks. (Risk Management Plan)

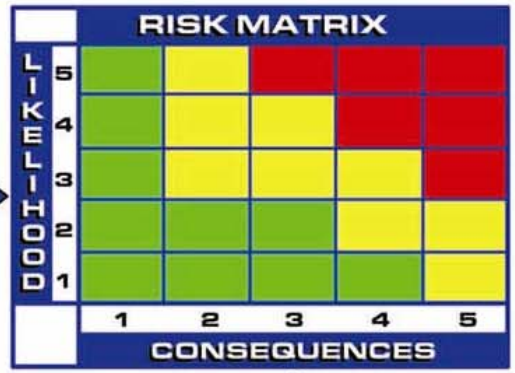
WATCH ITEM: A potentially significant threat that needs to be monitored closely. A WI can be effectively managed internally by the managing organization with existing team resources and processes (little coordination laterally or vertically is required for effective mitigation).

RISK MANAGEMENT: An organized, systematic decision-making process that efficiently identifies risks, assesses or analyzes risks, and effectively reduces or eliminates risks to achieving program goals. (Risk Management Plan)

INTEGRATED RISK MANAGEMENT APPLICATION (IRMA): The database is used to track risks and provide risk status for effective management. URL: http://mod.jsc.nasa.gov/irma

What is the likelihood the situation or circumstance will happen?

LIKELIHOOD Level	Probability	. . . or – the current process . . .
5	Very High	cannot prevent this event, no alternative approaches or processes are available.
4	High	cannot prevent this event, but a different approach or process might.
3	Moderate	may prevent this event, but additional actions will be required.
2	Low	is usually sufficient to prevent this type of event.
1	Very Low	is sufficient to prevent this event.



LEGEND

- High – Implement new process(es) or change baseline plan(s)
- Medium – Aggressively manage; consider alternative process
- Low - Monitor

RISK CONSEQUENCE SCORING TERMS

1. Cost is defined as the dollar amount required to mitigate the risk, not the cost of the risk if it occurs.
2. Schedule definitions: Level 2 Schedule relates to hardware delivery dates and Level 1 Schedule relates to launch dates.
3. Mission success consequence includes everything that is not cost, schedule, or safety: e.g., operations, programmatic, supportability, performance.
4. Cost, Schedule, Safety, and Mission Success Consequences can exist concurrently and are not mutually exclusive.
5. Risk scoring is accomplished by "multiplying" Likelihood X Consequence. When determining risk consequence among Cost, Schedule, and Technical, the highest score is represented in the Risk Matrix as a single score value.

What is the Consequence (Cost, Schedule, or Technical) of this Risk?

CONSEQUENCE Level	1	2	3	4	5
Cost	Minimal Impact of < $100K	Budget Increase between $100K and $1 Mil	Budget Increase between $1 Mil and $10 Mil	Budget Increase between $10 Mil and $50 Mil	Budget Increase of > $50 Mil
Schedule	Minimal or No Impact	Additional Activities Required. Able to Meet Need Dates	Level 1 Schedule or Level 2 Schedule Milestone Slip of ≤ 1 Month	Level 1 Schedule or Level 2 Schedule Milestone Slip of ≤ 1 Month, or Program Critical Path Impacted	Cannot achieve Major Milestone
Mission Success	Minimal or No Impact	Moderate Reduction, Same Approach Retained	Moderate Reduction, But Workarounds Available	Major Reduction, But Workarounds Available	Unacceptable, No Alternatives Exist
Safety	Could Cause the Need for Only Minor First Aid Treatment	May Cause Minor Injury or Occupational Illness, or Minor Property Damage	May Cause Substantial Injury or Occupational Illness, or Substantial Property Damage	May Cause Severe Injury or Occupational Illness, or Major Property Damage	May Cause Death or Permanently Disabling Injury, or Destruction of Property

NASA Risk Summary Card

NASA RISK MANAGEMENT

1 IDENTIFY

A. Early identification & management methods include: Budgetary Reviews, Expert Interview, Trend Analysis of Metrics, Comparison of Goals and Plans, Project Manager's Analysis and Reviews, Engineering Analysis and Trade Studies.
B. Key areas to assess include: Budget, Requirements, Technology, Management, Engineering Supportability, Logistics and Maintenance, Operations, Safety, Programmatic, Political.
C. Information Sources: Metrics, Historical Data, Resources, Suppliers, Plans, Proposed Changes, Test Results.
D. Is consideration given to all sources for identifying risks?

2 ANALYZE

A. Perform detailed engineering analysis.
B. Perform trend & sensitivity analysis.
C. Determine the likelihood of event.
D. Determine the item's consequences:
   1. Mission Success issues include: Performance, Operations, Crew Safety and Health, Programmatic Concerns, Logistics and Maintenance.
   2. Cost issues include: Program budget, Program threats, Program resources.
   3. Schedule.
   4. Safety.
E. Plot the risk on Risk Matrix.
F. Enter the risk & analysis data into the risk database.

3 PLAN

A. Conduct a trade study to identify the best risk abatement plan.
B. Develop the risk abatement plan to reduce likelihood of occurrence, reduce severity of consequences, redesign, develop prototypes, modify requirements, acquire resources, augment test or analysis, renegotiate, redeploy spares.
C. Develop contingency plans.
D. Recommend elevating risk to higher board/panel.
E. Enter abatement plans into IRMA and keep updated.
F. Are the mitigation plans adequate?
G. When a risk cannot be efficiently reduced/mitigated any further, consider accepting the risk.

4 TRACK

A. Watch and track the risk attributes and mitigation plans.
B. Watch and mitigate risks as related data are acquired, compiled, analyzed, and reported.
C. Use tracking reports to communicate information (quantitative and/or qualitative) required for effective control decisions.
D. Risk tracking can include use of metrics.

5 CONTROL

A. Process in which decisions are made based on the data presented in the tracking reports. This ensures that the risk is continually and effectively managed.
B. Decisions are based on current information as well as experience and must respond to changing conditions.
C. Risk decisions and current mechanisms should be integrated with standard project management practices.
D. Utilize tracking data to determine how to proceed with risks (close, continue tracking and executing the current plan, replan, or invoke a contingency plan).

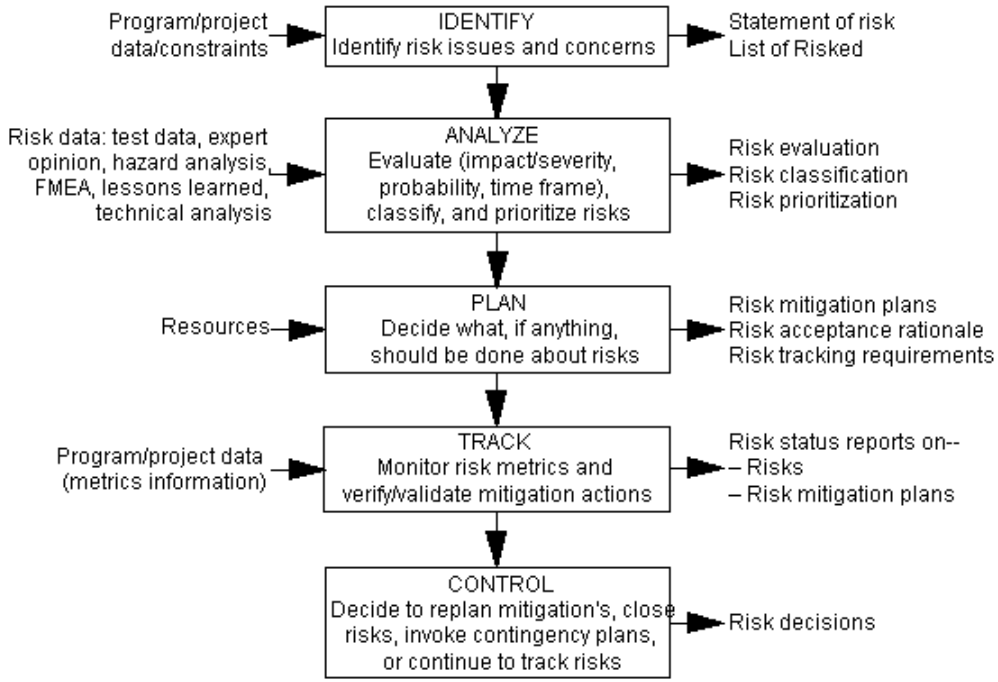
6 COMMUNICATE and DOCUMENT

A. Communication and Documentation: provide information and feedback to the Program on risk activities, risk status, and potential new risks.
B. Ensures the documentation and visibility of risk information for better management.

Continuous Risk Management

NASA views Risk Management as a continuous process:

- that identifies risks;
- analyzes their impact and prioritizes them;
- develops and carries out plans for risk mitigation, acceptance, or other action;
- tracks risks and the implementation of mitigation plans;
- supports informed, timely, and effective decisions to control risks and mitigation plans;
- and assures that risk information is communicated among all levels of a program/project



Risk Management Tools

Identify

- Requirements Development and Analysis, Testing, Operational Failures & Trend Analysis
- Test & Verification
- Cost & Schedule Analysis
- Anomaly Analysis/Resolution
- Probabilistic Risk Assessment
- Brainstorming
- Independent Assessment
- Lessons Learned DB
- Project Metrics
- Failure Modes & Effect Analysis (FMEA)
- Fault Tree Analysis (FTA)
- Hazard Analysis

Analyze

- Probabilistic Risk Assessment
- Root Cause Analysis
- Fault Trees/Event Trees
- Performance, Cost, Schedule Impacts Analysis
- Detailed Engineering Analysis
- Baseline Identification and Analysis
- Comparison Risk Ranking
- Taxonomy Classification
- FMEA
- Reliability Analysis

Plan

- Mitigation Planning/Fallback Plans
- Planning Decision Flowchart
- Brainstorming
- Cause and Effect Analysis
- Cost-Benefit Analysis
- Gantt Charts/PERT Charts
- Goal-Question-Measure
- Integrated Risk Management Application (IRMA) - Risk Database
- Lessons Learned DB

Track

- IRMA (Risk Database)
- Mitigation Status Report
- Risk Information Sheets
- Board/Panel Reporting
- Cost Reporting
- Gantt/PERT Schedules
- Stoplight Chart
- Project Metrics
- Threats Tracking Sheets

Control

- Cause and Effect Analysis
- Board and Panel Reviews/Reporting
- Resource Allocation (including Budget & Schedule)
- Mitigation Replanning
- Gantt Charts/PERT Charts
- Set Trigger Levels